agree with this conclusion. "It is quite possible," he writes, "that Belt's frog was *Atelopus varius*, Stannius, but it is more probable that it was *Dendrobates typographus*, Keferstein (*ignitus*, Cope), which occurs also in Nicaragua. All the *Dendrobates* appear to be very poisonous."

The section on mimicry of ants—one of the most important in the work—is enriched by an excellent summary, on pp. 114–23, of Wasmann's splendid researches.

Vosseler's account of the life-history of the Locustid *Eucorypha fallax* is given at considerable length and illustrated, on pp. 107–12. An ant-like larval stage of this insect was described long ago as *Myrmecophana fallax* by Brunner von Wattenwyl, and it is most satisfactory that Vosseler's excellent observations have now put this often-quoted example of mimicry in its true position. He shows that "after the fourth change of skin" there is "a change from a mimetic to a cryptic appearance," the succeeding stage being leaf-like in colour and exhibiting a correspondingly altered behaviour. The change thus begun continues to the end, the winged imago being beautifully leaf-like. In correspondence with these changes Vosseler does not admit that any feature in the likeness is unnecessary. And yet this was one of the very cases on which Brunner founded his conception of "hypertelic" resemblance, or resemblance that attains an altogether unnecessary perfection in detail—that is, in fact, "too good to be true."

The illustrations, especially those that are coloured, are rather rough, but they are, on the whole, well selected and serve their purpose. It is a pity that the two species of Heliconius figured on pp. 144 and 145 were not accompanied by *Melinaea imitata* and *Mel. ethra*, instead of *Mechanitis doryssus* and *Mech. lysimnia* respectively. If room could be found for only one Ithomaeine, there is no doubt that Melinaea should have been the genus selected. The mimetic females of the African *Papilio dardanus* are so complicated that much care is required to avoid mistakes. It is unfortunate that the only characteristic eastern and south-eastern Danaine model, *Amauris echeria*, and mimetic form (*cenea*) of *dardanus* should be described on p. 163 as West African.

But when every criticism has been urged, we must admit that the book will be very useful. Haase's important monograph is too large and expensive to be likely to reach many hands, and we welcome the appearance of a German work of small price and moderate size, which will serve as an introduction to this interesting and much-debated subject.

E. B. P.

TEXT-BOOKS OF CHEMISTRY.

(1) *General Chemistry Laboratory Manual.* By Prof. J. C. Blake. Pp. x+166. (New York: The Macmillan Company; London: Macmillan and Co., Ltd., 1913.) Price 8*s.* net.

(2) *Practical Chemistry.* Qualitative Exercises and Analytical Tables for Students. By the late Prof. J. Campbell Brown. Sixth edition. Edited by Dr. G. D. Bengough. Pp. 78. (London: J. and A. Churchill, 1913.) Price 2*s.* 6*d.* net.

(3) *Organic Chemistry for Students of Medicine.* By Prof. J. Walker, F.R.S. Pp. xi+328. (London: Gurney and Jackson; Edinburgh: Oliver and Boyd, 1913.) Price 6*s.* net.

(4) *Quantitative Analysis in Practice.* By Prof. J. Waddell. Pp. vii+162. (London: J. and A. Churchill, 1913.) Price 4*s.* 6*d.* net.

(5) *La Catalyse en Chimie Organique.* By Paul Sabatier. Pp. xiv+255. (Paris and Liège: Librairie Polytechnique, Ch. Beranger, 1913.) Price 12.50 francs.

(1) THE exercises in this manual are complementary to the author's "General Chemistry: Theoretical and Applied," and accordingly the work can scarcely be recommended to chemical students in general unless they are taking a course very similar to that planned by the author. About one-half of the book, which is interleaved throughout with blank pages for students' notes, is devoted to simple experiments, partly qualitative and partly quantitative, dealing with the chemistry of non-metallic ("acid-forming") elements. The experiments on the metals ("base-forming elements") might serve as an introduction to inorganic qualitative analysis, but would be of slight educational value unless accompanied by a course of lectures on the theory of analysis. A few simple experiments on the atmosphere, the soil, fuels, and oils, natural waters, the ferrous metals, and rocks are grouped under the heading of applied chemistry.

(2) This treatise, like the foregoing manual, is chiefly of interest as affording an indication of the subject-matter chosen for experimental study in the author's practical classes. These exercises are preceded by the following general instruction: "After performing each of the following exercises, the student should record the reactions in his notebook in the form of equations whenever an equation is possible." This excellent instruction, if conscientiously obeyed by the student and carefully supervised by a sympathetic demonstrator, would go far towards making the work educational. Yet without previous knowledge gained either from text-books of general chemistry or from lectures on the theory of analysis, the student

would scarcely be in a position to express the reactions in the form of equations. The explanations given in the text are fragmentary, and sometimes obscure and even misleading. This lack of information is specially noticeable as regards the action of solvents. No explanations are given of the solvent action of ammonium chloride on the hydroxides of magnesium and manganese, or of the changes which occur on dissolving silver chloride in ammonia, potassium cyanide, or sodium thiosulphate. It is extremely doubtful whether the reducing action of alkaline stannous chloride on bismuth hydroxide leads to the sub-oxide Bi_2O_2, or whether the interaction of potassium cyanide and copper salts gives rise to the double cyanide $K_2[(CN)_4Cu]$. Some explanation seems desirable for the instruction (pp. 24 and 39) to use "stale $NH_4.HCO_3$." On the whole, however, the working instructions are quite practicable, but, in the section devoted to the rarer elements, a distinction might, with advantage, have been made between tests requiring considerable concentrations and those appreciable even in very dilute solutions. Cerium dioxide (p. 27) is not red unless contaminated with other rare earths. The final sections of the book are devoted to organic qualitative analysis, including tests for a typical series of organic acids and the characteristic reactions of the principal organic bases with separation tables for the commoner alkaloids.

(3) In order to meet the requirement of students of medicine whose time for the study of chemistry may not exceed six months, the author has selected the chemical substances considered in the course chiefly on account of their medical interest. A novel feature in the work is the postponement of the consideration of nitrogenous compounds to the last third of the book. In spite of the condensation necessary in the circumstances, the author has succeeded in giving adequate explanations of several important and difficult subjects, such as stereoisomerism, the chemistry of the naturally occurring sugars, the cyanogen derivatives and organic amines, including alkaloids. In other shorter sections a more sketchy outline has been regarded as sufficient, but the subjects are always dealt with so suggestively that the work can be recommended as a useful introduction to the study of organic chemistry not only for medical students, but also for others requiring a general outline of the subject dealing with substances of practical interest.

(4) An introductory course of quantitative analysis in which the author lays special stress on the speed with which analytical work should be carried out. Thoroughly practical directions are given for carrying out fifteen typical exercises, and the time required for completing these analyses is indicated in each case. The analytical processes are connected with the general chemical principles underlying these operations. For example, the precipitation of magnesium ammonium phosphate affords an opportunity for discussing the chemistry of phosphoric acid and its salts. In the separation of nickel and cobalt, considerable saving of time would be effected by substituting for the double nitrite method the processes based on the use of nitroso-β-naphthol or dimethylglyoxime. The appendix contains useful sections on the chemical balance, calibration, electrolyte dissociation, and indicators.

(5) This work is a valuable *résumé* from the pen of one whose name will remain inseparably linked with the subject of "Catalysis in Organic Chemistry." The introductory chapter dealing with autocatalysis and negative catalysts is followed by sections devoted to the general survey of substances utilised as catalysts in organic chemistry, catalytic oxidations and hydrolyses, and the catalytic introduction into organic molecules of halogens, sulphur, metals, and the carbonyl and sulphonic groups. Five chapters are devoted to the important subject of catalytic hydrogenation. Although the action of metals in accelerating the addition of hydrogen to organic and inorganic substances had been known since the commencement of the nineteenth century, the systematic study of this process, which was first initiated by the author and Senderens in 1897, has since led to the development of a valuable general reaction in organic synthesis based on the employment of finely divided nickel. Due reference is made to the special processes of hydrogenation devised by Ipatieff, Paal, and Willstätter. The action of the metallic catalyst in inducing the reverse change of dehydrogenation has also been demonstrated by the author and by Zelinsky and others. In collaboration with Mailhe, the author investigated systematically the dehydrating action of the refractory metallic oxides (alumina, thoria, tungsten oxide, &c.), and laid the foundation of another general reaction in which the alcohols are converted into unsaturated hydrocarbons. Conducted in the presence of ammonia, hydrogen sulphide or organic acids, these dehydrations lead respectively to organic amines, thiols, or esters. Bearing in mind the author's brilliant achievements in this field, his views on the mechanism of catalysis are of special interest. Whether occurring in homogeneous or heterogeneous systems, catalytic change is regarded as being due to the successive

formation and destruction of unstable intermediate compounds, the author asserting that this theory, in spite of certain imperfections, has been the guiding beacon in all his researches on catalysis.

G. T. M.

MATHEMATICS: PURE AND APPLIED.

(1) *Vectorial Mechanics.* By Dr. L. Silberstein. Pp. viii + 197. (London: Macmillan and Co., Ltd., 1913.) Price 7*s.* 6*d.* net.

(2) *An Introduction to the Mathematical Theory of Attraction.* By Dr. F. A. Tarleton. Vol. ii. Pp. xi + 207. (London: Longmans, Green and Co., 1913.) Price 6*s.*

(3) *A First Course in Projective Geometry.* By E. Howard Smart. Pp. xxiii + 273. (London: Macmillan and Co., Ltd., 1913.) Price 7*s.* 6*d*

(1) DR. SILBERSTEIN'S "Vectorial Mechanics" is an able exposition of the power of vector analysis in attacking certain types of physical problems. Heaviside's modification of Hamilton's original vector and scalar notations is adopted throughout. So far as the simpler applications of vector analysis go, the question of notation is apparently of little consequence. Almost every vector analyst who writes a book on the subject has his own pet notation; and there is a tendency for these authors to fail to recognise that their best creations are usually Hamilton's originals disguised. Even Dr. Silberstein, who knows and works quaternions, ascribes to Heaviside a formula given long ago by Hamilton, assigns to Clifford (1878) a problem which is completely solved in the first edition (1867) of Tait's "Quaternions," and refers to Henrici and Turner as authorities in connection with a simple geometrical problem given in Kelland and Tait's "Introduction to Quaternions." One might with as much historic truth ascribe the proposition Euclid i. 47 to the first English examiner who set it in an examination paper. Indeed, the historic references throughout the book are not all that might be desired. For example, it is incorrect to speak of Willard Gibbs as the one to whom, after Hamilton, the discovery of the fundamental properties of the linear vector function is due. What of Tait's powerful paper of 1868 on the rotation of a rigid body about a fixed point? It positively bristles with new-found properties and applications of the linear vector function. Dr. Silberstein's own chapter v. is simply a reproduction of part of this memoir. Then in the second edition (1873) of his treatise on "Quaternions," Tait for the first time develops the application of the linear vector function to strains; and in the last chapter of Kelland and Tait's "Introduction to Quaternions" (1873) presents the theory in a different form. Willard Gibbs's "Vector Analysis" (not published) was printed for the use of his students in 1881 and 1884. Apart from new names and a new and extremely interesting presentation, it is doubtful if Gibbs gave in that pamphlet any important property of the linear vector function which was not to be found in the pages of either Hamilton or Tait.

Then as regards the differential operator ∇ it was unquestionably Tait who, first in his paper on Green's and allied theorems (1870), and afterwards in his treatise on quaternions (second and third editions), developed it and showed forth its power. Willard Gibbs got it partly from Tait's "Quaternions" and partly from Maxwell's "Electricity and Magnetism"; and Maxwell got it directly from Tait. Yet while giving great credit to Gibbs and Heaviside, Dr. Silberstein does not mention Tait's name once. The manner in which Dr. Silberstein leads up to Stokes's "Theorem" is not convincing, that is, if the explanation is meant to be a proof. Phrases like "we may conclude" and "we may consider" are scarcely satisfactory in establishing a far-reaching mathematical transformation. Moreover, no attempt is made to establish the useful vector extensions of the theorems of Gauss and Stokes. It is, indeed, in these integral theorems involving the ∇ that, as compared with the quaternion vector analysis, the artificiality of other vector analyses mainly appears. The transformations lack flexibility. The reason for this is that outside the quaternion vector analysis the reciprocal of a vector is tabu, and the associative law in products is despised.

Apart from the necessary imperfections of a non-associative vector algebra, Dr. Silberstein's book contains many good things. In his treatment of the rotation of a solid body and of strain there is not so much of novelty, except when in the latter case he considers discontinuous motions. In the chapter on hydrodynamics, however, there are certain interesting developments which demonstrate the directness and value of vector methods. On p. 143 the long-winded semi-Cartesian transformation is needlessly laborious; for at once in quaternion notation:

$$S\sigma\nabla\,.\,\sigma = V\sigma V\nabla\sigma + \nabla_1 S\sigma_1\sigma = V\sigma V\nabla\sigma + \tfrac{1}{2}\nabla\sigma^2,$$

where σ is the fluid velocity.

(2) After a lapse of fourteen years Prof. Tarleton has brought out the second volume of his "Introduction to the Mathematical Theory of Attraction," the first volume of which was reviewed in NATURE for April 29, 1899. The chapters are numbered consecutively with the chapters of the first volume. An elegant discussion of spherical and ellipsoidal harmonics occupies chapter viii. In chapter ix. the author develops on familiar